If for this reason alone, his insistence that the success of small holdings depends upon cooperation, and that cooperation ultimately depends upon education, we can most cordially recommend Mr. Rider Haggard's book to everyone who is interested, either directly or indirectly, in the welfare of the rural population.

THE SEWAGE PROBLEM.

Sewage Disposal. By Prof. L. P. Kinnicutt, Prof. C. E. A. Winslow, and R. W. Pratt. Pp. xxvi+436. (New York: J. Wiley and Sons; London: Chapman and Hall, Ltd., 1910.) Price 12*s*. 6*d*. net.

THE economic solution of the important problem of sewage purification depends for its success on the careful application of engineering principles to the numerous physical, chemical, and biological changes involved. It is therefore with pleasure we find a volume devoted to the subject which is the result of collaboration between distinguished American representatives of chemistry, biology, and engineering, particularly so when each of the individual authors has had wide experience in the practice of sewage purification and disposal.

It is stated in the preface that this work was in progress before several of the recent publications on sewage purification had appeared; the authors, however, claim that there is still room for a general survey of the subjects with particular reference to the conditions of American practice. This claim is certainly justified by the careful way in which world-wide information in regard to the various methods of sewage purification has been collected, and by the admirable manner in which the subject-matter is presented.

From the point of view of American practice it is not surprising to find that separate chapters are devoted to the consideration of the questions of sewage purification or disposal by dilution, and of intermittent sand filtration. The former question receives thorough treatment, and the conditions necessary for the adequate purification of sewage discharged into waterways are discussed at length. Interesting examples are given of the self-purification of rivers receiving sewage. While this method of disposal is rendered possible in many cases in America by reason of the relatively large volume of the rivers, it is, of course, for obvious reasons, scarcely practicable in the case of inland towns in England.

The question of the preliminary treatment of sewage by the various tank processes, and also that of the disposal of sludge, is thoroughly dealt with in chapters iv. to vii., inclusive. Under the head of the septic process, the Hampton hydrolytic tank is described in detail, and the Emscher tank of Imhoff receives notice. The Hampton doctrine on the theory of sewage purification is given careful attention, and the authors' conclusion in regard to the relative value of this theory as compared with the views advanced by Dunbar will probably meet with general approval by those actually engaged in the work of sewage purification.

It is interesting to note that when discussing the bacteriology of intermittent filtration, no reference is made to the theory recently promulgated of direct nitrification of organic nitrogen, the authors evidently being in agreement with the generally accepted view of the preliminary formation of ammonium compounds.

In subsequent chapters is given a comprehensive survey of the question of the purification of sewage on contact beds and percolating filters respectively, illustrated by numerous examples of purification works in England, America, and on the Continent. The authors' review of the relative merits of the two systems of filtration may, in general, be commended. It is to be feared, however, that the quantities of sewage actually dealt with by percolating filters will be found on investigation to be considerably lower than those given in table lxxxv., especially when the time the filters are out of operation is taken into consideration.

Exception must also be taken to the authors' statements that the results obtained at Croydon, which are quoted on p. 372, afford an excellent idea of the comparative efficiency of contact beds and percolating filters.

These results give an entirely erroneous impression as to the possibility of contact beds, inasmuch as the purification mentioned of from 40 to 47 per cent., is certainly much below the results generally obtained when working at so low a rate as 46 gallons per cubic yard per day.

The concluding chapters are concerned with the disinfection of sewage and sewage effluents, and the methods of analysis.

In view of the present tendency amongst certain English sanitarians, it is important to observe that in the opinion of the authors, it has not yet been demonstrated that any electrolytic process for making chlorine at the sewage plant, unless free power is available, is as economical as the purchase of the ordinary commercial product.

This work can be thoroughly recommended to all interested in sewage purification, more particularly as the authors themselves do not dogmatise on the subject, but are successful in presenting in a lucid manner both the principles involved in the problem of sewage treatment, and the various views and theories which have been advanced by leading investigators. A clear statement of the present position of the subject is thus afforded. The value of the book is enhanced by the excellent list of references, which will be found of considerable use to those engaged in sanitary work.

EDWARD ARDERN.

FACT AND HYPOTHESIS IN BIOLOGY.

Lectures on Biology. By Dr. Curt Thesing. Translated from the second edition by W. R. Boelter. Pp. viii+334. (London: J. Bale, Sons, and Danielsson, Ltd., 1910.) Price 10s. 6*d*. net.

THIS book could be heartily recommended to readers who wish for a modern presentation of general biological discovery were it not for the pseudo-philosophical limitations which the author imposes upon each and every hypothesis that has been advanced to account for the facts. The arguments that

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go to prove the truth of evolution are skilfully and attractively marshalled, but that is not the author's chief object. What he aims at is to show that the selection-hypothesis only applies to a limited field, that use-inheritance has its restricted place, and so on; in short, that all our explanations are partial, and that in none of them can we have complete confidence.

When we come to ask on what grounds this want of confidence is asserted, we find the old objections answered fifty years ago by Huxley put forward as if they were discovered yesterday. "Darwinism yields no information concerning the causes of variability" (p. 210); "the theory of natural selection is the doctrine of chance"; "the theory of mutation plays with chance even more than selection." What is Darwinism but a method? The author uses this word as if it implied a corpus of knowledge which could not be extended, and was to be judged by its expression in the writings of casual essayists. In only a single place does he refer either to the "Origin" or to "Variation under Domestication," though he quotes extensively from modern critics. It is idle talk to say that Darwin did this, but not that as though one man could do all, or as if Darwin claimed a complete supremacy for his selection hypothesis. Are we to have no confidence in the theory of natural selection because its discoverer was not able to give a complete treatment of variation? One would really conclude from this book that variation was a subject to which Darwin gave no serious consideration. The old goddess "chance" is once more used as a stick to beat the dog "selection" with, and we become rather tired at the iteration of arguments urged and rebutted any time these thirty years. Even the old crude presentation of the Miltonian "creation" is made to stand up in order to receive fresh blows.

The book is sadly in need of competent revision. The number of misprints is really irritating. Amongst the animals of the tropics we are told there is the leopard and the *gepard,* a creature the nature of which is wholly problematical. The choristers at Rome have well developed "mammals" (p. 148); "*Omni* vivum e vivo" (p. 97); "like all other infusorians, no bell-animalcule is able to reproduce by simple fission" (p. 230); the vermiform appendix "has no function whatever, its object being rather apparently to create suffering." On p. 129 Balanoglossus is classed with Vermes, and the larvæ of Crinoids are termed Bipinnaria, whilst on p. 130 the larvæ of starfish are correctly called by that name, but the figure refers to an Auricularia or Holothurian larva. In his condemnation of sexual selection the author entirely overlooks the careful observations by Mr. and Mrs. Peckham on the spiders of the family Attidæ, and as these support the Darwinian position the whole criticism falls to the ground.

Apart from critical matters, the book is full of interest, and its summary of recent work on heredity is but one example of the wide reading and careful exposition which the author exhibits. Read with due caution the book can only do good.

AN AMERICAN COLLOQUIUM.

The New Haven Mathematical Colloquium. By E. H. Moore, E. J. Wilczynski, and Max Mason. Pp. x+222. (New Haven: Yale University Press; Oxford: University Press, 1910.) Price 13*s.* 6*d.* net.

In the autumn of 1906, at the meeting of the American Mathematical Society, three short courses of lectures were delivered to the assembled experts, and are here published for the benefit of the world at large, or at any rate for that of such persons as are interested in the most recent aspects of pure mathematics. The authors assume that their hearers have a good knowledge of analysis, and the reviewer must do the same, in order to keep within due limits.

Prof. Moore's discourse is an introduction to general analysis, which may be described as an essay on the "functional theory" of Fréchet and others. A free use is made of the Peano stenography, and this is one more sign of a fact which some of us will admit with regret, namely, that students of the logical side of mathematics must become proficient in Peanese.

Two important ideas play a leading part in Prof. Moore's discussion. The first is the dominance of one function by another; μ_1 is dominated by μ_2 if, for every argument p, the absolute value of $\mu_2(p)$ is not less than the absolute value of $\mu_1(p)$. The other, which appears to be both new and important, is that of uniform convergence relatively to a function σ. Thus we have a notation

$$\mathrm{Lt}_n \, \mu_n = \mu \; (\mathrm{R}\,;\, \sigma),$$

meaning that when R is the range of the variable x, and $(\mu_1, \mu_2, \ldots)$ is a sequence of functions of x, this sequence converges in such a way that, by taking n large enough, and for all greater values of n, $|\mu - \mu_n| < e[\sigma(x)]$, where e is any assigned positive number; and if n can be determined by means of e alone (without x), we have uniform convergence relative to σ. When σ is constant, we come back to the usual definition of uniform convergence. The second part of the essay is on composition of classes, which may be described as a generalisation of the theory of the composition of moduli and ideals in the theory of numbers.

In connection with a certain notation, the author remarks that "the intention is to discriminate sharply between function and functional value." With this we confess we are in sympathy, though, of course, we shall be told that a function is merely an enumeration of values, either actually or potentially complete. In the abstract, of course, this is undeniable; but consider the function $\sin x$, for example. Its property of being periodic is intrinsic, and was actually realised before there existed a table of its values, or rather it was made part of a generalised definition of $\sin x$. Again, the class of algebraic numbers, or that of algebraic functions, surely has a significance apart and beyond the aggregate of values associated with it.

The next essay is upon projective differential geometry, especially in connection with ruled surfaces. Various results of great interest and generality are obtained by the author; for instance, it appears that

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